Event anisotropy as a probe for jet quenching

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In ultra-relativistic heavy-ion collisions hard processes happen early in the reaction processes and thus can be used to probe the early stage of the evolution of a dense system. During this early time a quark-gluon plasma (QGP) could exist. Associated with hard processes are jets, however, when the transverse energy of the jets becomes smaller it becomes increasingly difficult to resolve them from the "soft" particles. These jets with $E_T < 5$ GeV are usually refered to as mini-jets. At RHIC energies it has been estimated that 50% of the transverse energy is produced by mini-jets.

It was shown that medium induced radiative energy loss of high p_t partons (jet quenching) is very different in a hadronic medium and a partonic medium. Recently it was shown that this energy loss per unit distance, dE/dx, grows linearly with the total length of the medium L. For non central collisions the hot and dense overlap region has an almond shape. This imposes different path lengths and therefore different dE/dx for particles moving in the in-plane versus the out-plane direction.

To study this anisotropy with respect to the reaction plane, 100 000 Au+Au collisions at $\sqrt{s} = 200$ AGeV have been generated using the HIJING[1] v1.35 monte carlo. The coefficients used to characterize this anisotropy are the same as used in flow analysis and are called v_1 and v_2. A non zero v_1 indicates a direction for the particle "flow" and a non zero v_2 indicates that the azimuthal distribution has an elliptical shape. At a given rapidity and p_t interval the coefficients are determined by[2],

$$v_n = < \cos[n(\phi - \Psi_r)] >,$$

where Ψ_r denotes the reaction plane angle.

Footnotes and References

[1] M. Gyulassy and X.-N. Wang, Comp. Phys. Comm. **83** 307 (1994).

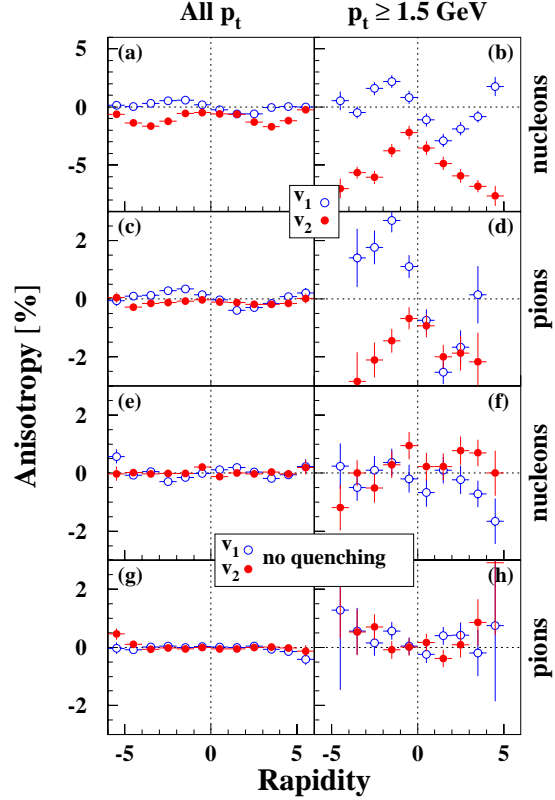[2] S. Voloshin and Y. Zhang, Z. Phys. C **70**, 665 (1996).

Figure 1: *Anisotropy parameters for nucleons and charged pions in HIJING, using an impact parameter range of $5 \leq b \leq 10$ fm.*

Figs. 1a-d show v_1 and v_2 for nucleons and charged pions. The coefficient v_1 shows a negative slope around mid-rapidity for both nucleons and pions and this becomes more pronounced for particles with $p_t \geq 1.5$ GeV. The coefficient v_2 is negative over the whole rapidity range for both charged pions and nucleons. For particles with $p_t \geq 1.5$ GeV, v_2 becomes more negative especially at forward and backward rapidity. The precise shape depends on the dN/dy distribution and the quenching mechanism and is being studied. Figs. 1e-f show that without jet quenching the anisotropy coefficients become zero. This indicates that interactions among particles, either quenching or rescattering, are important in producing the anisotropy.